NRL Report 5175

SUPERSEDES NRL REPORT 4400

THE SCIENTIFIC PROGRAM OF THE U.S. NAVAL RESEARCH LABORATORY

July 1, 1958

U.S. NAVAL RESEARCH LABORATORY
Washington, D.C.

FOREWORD

The mission of the U.S. Naval Research Laboratory is to support the Chief of Naval Research in his effort to preserve national security by initiating, planning and conducting in the physical sciences, applied research and development to meet the immediate needs for equipment and materials to increase the combat effectiveness of the Navy, and fundamental research and experimentation in anticipation of future requirements.

In an organization of the size and complexity of the Naval Research Laboratory, some means of classification is necessary to bring its varied activities together in an orderly and systematic form for purposes of planning, reporting, and over-all management. The NRL Scientific Program serves this function.

The pages which follow present the current approved program of research and development of the Naval Research Laboratory. This document describes the areas of technology – both fundamental and applied – in which the Laboratory is now working or in which it believes it should work. There is shown a breakdown of the scientific effort into the individual programs specifically identified and systematically catalogued. The sum of the individual programs makes up the Laboratory program.

The program is designed to make the best use of the resources of the Laboratory in research and development to meet the more pressing needs of the material bureaus and operational requirements as defined by the Chief of Naval Operations.

All scientific activities at the Laboratory are classified into twelve fields. Each of these fields is further subdivided into a number of discrete programs designated by a letter indicating the field and a number indicating the specific program in that field. This program is a revision of that dated July 1, 1954 (NRL Report 4400).

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Director

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APPLICATIONS RESEARCH

Y01 - DATA PROCESSING

The purposes of this program are to study the factors involved and to develop techniques which will increase the effectiveness of combined electronic information systems. In particular, attention is concentrated on those systems leading to the rapid and accurate exercise of command. The latter requires techniques and devices for the processing and display of information provided by systems associated with detection, identification, tracking, designation of targets, and control of friendly aircraft.

Electronic processes and techniques are being developed and evaluated for performance of the processing and display functions.

Y02 - ENGINEERING PSYCHOLOGY

The aim of this program is the development of more easily and effectively operated electronic and mechanical equipment. Studies of human behavior are conducted and are aimed at obtaining information which will guide engineers in the design of the mechanical components of man-machine systems (such as radars, fire-control systems, aircraft) so that the machine operation requirements fall within human capabilities.

The ability of the human to perform tasks corresponding to different mathematical processes is being tested as an aid toward developing an operator-oriented servo approach which will be more useful to design engineers than those employed today. In other studies the human is viewed as a communication channel which mediates the transmission of information from the display to the control. In still others, research is being conducted on the capabilities of the human eye, ear, and other sense organs with particular attention to those aspects of sensation and perception related to the operation of man-machine systems.

Finally, development work is proceeding along the following lines: (1) the human engineering aspects of the design of specific gun sights, aircraft and ship control systems, and other military equipment, and (2) the design, development, and initial testing of displays, controls, and electronic control circuits especially adapted to human response characteristics and intended to improve man-machine system performance by a substantial amount.

Y03 - SYSTEMS ANALYSIS

It is the purpose of this program to investigate both theoretically and experimentally the operation of naval information-handling systems.

Activity is proceeding along the following general lines:

(1) Preliminary quantitative evaluation of systems, using mock-ups and simulated inputs.

(2) Experimental determination of the quantitative parameters of systems, such as data-handling ability, time delays, accuracy.

(3) Theoretical analysis of systems using mathematical and symbolic models.

(4) Study of the factors entering into decision making in naval systems.

(5) Operations research on the external factors affecting the ability of a system to accomplish its mission.

(6) Operations research studies of new devices and weapons to determine their optimum integration into naval systems.

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ASTRONOMY AND ASTROPHYSICS

A01 - ASTRONOMY

The program in radio astronomy is conducted with emphasis on studies concerning decimeter, centimeter, and millimeter wave emission from celestial sources. Studies on the emission from the sun are made in order to measure the electron density and other properties of the solar body and its parts, and are correlated with observations on terrestrial magnetic storms and cosmic-ray phenomena. Similar measurements on emission from the moon are made to garner information on the moon's surface. For basic understanding of our galaxy and others, the continuous radio emission is monitored from visible celestial objects such as stars and nebulae, and from invisible "radio stars." Important techniques which are used for mapping our own galaxy, the Milky Way, include line spectral studies of the emission from interstellar gases such as hydrogen. Other activities in this program include the application of radio astronomy to navigation and to meteorology, and the development of special radio techniques involving ultrasensitive detectors.

High-altitude research rockets are utilized in the program on rocket astronomy. The ultraviolet and x-ray emissions of the sun, the stars, nebulae, and interplanetary and interstellar space are measured by means of rocket-borne instruments which include photon counters and ionization chambers sensitive in narrow bands of the x-ray and ultraviolet spectra, and high-dispersion spectrographs which are applied to solar spectroscopy. Results in this program have disclosed intense ultraviolet radiations from stars and nebulae and strong nighttime ultraviolet radiations of hydrogen in the vicinity of the earth's orbit around the sun. These investigations open a new avenue of knowledge about cosmic-terrestrial relationships.

A02 - ATMOSPHERE

Studies of the upper atmosphere using rockets, balloons, and aircraft include measurements of physical parameters such as pressure, temperature, and wind velocities; the effect of solar radiations; the atmospheric composition; natural and induced radioactivity; cosmic rays; and the development of high-altitude photographic techniques. Through the use of rockets and artificial satellites, other phenomena in both the upper atmosphere and outer space are studied, including the earth's magnetic field to great distances, the aurorae, the incidence of meteors, and various effects produced upon the upper atmosphere. Atmospheric electric phenomena such as the electric field about the earth, the conductivity of the atmosphere, the air-to-earth current, and the type, size, and charge of atmospheric ions and condensation nuclei are important parts of this program; all these are observed at various altitudes and from the earth at widely scattered locations. These extreme-altitude rocket studies and satellite experiments contribute to such military applications as weather reconnaissance, general reconnaissance and surveillance, communication and navigation.

Phenomena of interest in the lower atmosphere include the optical properties of the atmosphere in scattering and absorption of radiations throughout the ultraviolet, visible, and infrared regions of the spectrum by clear air, haze, and fog. The results are applied directly to many military problems such as optical signaling, visibility through the

atmosphere, target detection, thermal effects of nuclear explosions, missile guidance, aerial navigation and communications, landing of aircraft, and the visibility of aircraft at high altitudes.

A03 - METEOROLOGY

Research and development are conducted on new and improved methods and instruments for measuring and interpreting phenomena of the lower atmosphere with the objective of reducing meteorological hazards and increasing utilization of meteorological conditions in military operations.

The program includes work on new methods for measuring, telemetering, and recording meteorological parameters (temperature, humidity, pressure, wind velocity, etc.) as a function of time and position of sensors placed on the ground, in aircraft, aboard ship, and on balloons. Studies are made to determine the meteorological significance of parameters not now generally used in meteorological applications by the Department of Defense.

CHEMISTRY

C01 - FUELS

Current and potential fuels are being investigated for use in rocket, aircraft, and marine propulsion engines. Of immediate concern are the following areas:

(1) Factors influencing thermal and storage stabilities and the development of methods for predicting stability.

(2) Fundamental studies on ignition and combustion with emphasis on the role played by "cool flames" and the effects of molecular structure.

(3) The properties of the interface between fuels and water and the development of new techniques to study these.

(4) Fuel handling with emphasis on cleanliness and hazards from radio-frequency and triboelectric sparks.

(5) Study of selected rocket fuels and oxidizers and factors affecting their decomposition.

High-energy fuels such as boron hydrides are under investigation to determine methods of preparation, physical and chemical properties, and storage and handling characteristics. Fundamental studies are conducted on slow-burning solid monofuels, and the use of such fuels to furnish specific charges for existing devices (pressurizing containers such as fire extinguishers, or driving small turbines), is under investigation.

C02 - SURFACE CHEMISTRY AND LUBRICANTS

Exploratory research is continuing on the physical, colloidal, and chemical properties of liquid, gelled, and solid lubricants; emphasis is on synthetic lubricants because of the inability of petroleum products to satisfy some military requirements. Basic research is being conducted on the relation of physical and chemical properties of liquids to molecular structure; on the mechanism of liquid-phase oxidation and mode of action of antioxidants; on friction and wear properties of liquids and solids; and on physical and chemical properties of soap-gelled and non-soap-gelled greases. Studies of adsorption-desorption equilibria, wettability, and electrode potentials at solid/liquid, solid/air, liquid/liquid, and liquid/air interfaces are being pursued. Mechanisms involved in the surface chemistry of modern high explosives are also under investigation with emphasis on desensitizing explosives. Exploratory research is in progress on (1) effects of chemical constitution on micellar behavior and colloidal properties of oil-soluble soaps, (2) the solubilizing power of such soaps, and (3) the mechanisms by which these soaps function as rust inhibitors, oiliness additives, detergents, and gelling agents. The adhesion of ice to naval equipment is under investigation utilizing the fundamental concepts of surface chemistry.

C03 - PROTECTIVE SURFACES

Investigations are being made of the chemical and physical phenomena associated with the degradation of material by exposure to natural environments, which include naturally occurring organisms. Moreover, methods and techniques which are designed to eliminate or at least retard rates of deterioration of material are under continuing development. Paint systems are being improved to retard the degradation rates of metal surfaces to which they are applied. There are under study functional coatings which improve the operating range or efficiency of components of weapons systems. These include daylight fluorescent paints for purposes of recognition; antifouling paints for flying-boat hulls and acoustical surfaces of sonar gear; and paints of high emissivity and reflection for aiding in the control of temperatures in satellites and rockets. Basic studies of newer resins and polymers are now in progress to determine their adaptability to these and related problems.

Coatings are under development for improving the storage characteristics of fuels in both concrete and steel facilities. These studies are being extended to include exotic high-energy fuels as well as those derived from petroleum. The chemical characterization of creosote, now used extensively for piling, is being determined to assist in developing better repellents for marine borers. The relationship of biological activity to chemical composition is being studied with a view toward development of more potent fungicides. An exposure station and a corrosion laboratory are maintained in the Canal Zone to study deterioration and corrosion of materials and equipment in a natural tropical environment.

C04 - HIGH POLYMERS

The program in high polymers concerns both chemical studies and application of polymeric materials. New polymers are synthesized and examined with the objective of producing improved or more useful materials. These include plasticizers, organophosphorus compounds, and other components or process chemicals used in or for rubber and plastics. The design, compounding, and production of a limited number of special items such as unusual seals and electromagnetic wave absorbers are under way.

C05 - PHYSICAL AND ELECTROCHEMISTRY

Physical and chemical properties of liquid metals, fused salts, and other heat transfer media are under study to collect fundamental data which could be valuable in the design and operation of heat exchange systems such as used in nuclear reactors. Thermal conductivity, specific heat, viscosity, density, and solubilities of impurities have been determined on sodium, potassium, and their alloys, and are being determined on other metals such as lithium and mercury. The fundamental relationship of thermal conductivity to electrical conductivity is being studied in a great variety of materials utilizing the concepts of electronic and molecular conduction.

Basic research in electrochemistry is conducted on the mechanisms involved in electrode reactions utilizing the principles of thermodynamics and kinetics, and the techniques of x-ray and electron diffraction, electron microscopy, metallography, and microscopy. Specific studies include the crystal structure and phase transformations of the lead oxides and sulfates, the influence of subgrain structure and microsegregation of the electrodes on the corrosion and growth processes, hydrogen overvoltage and hydrogen-producing reactions on noble-metal electrodes. Types of storage batteries under study

include lead-acid, silver oxide-zinc alkaline, nickel-iron, and fuel cells. In addition to these cells, the basic studies will continue to have broad applications in such other fields as electroplating and the mitigation of corrosion.

C06 - RADIOCHEMISTRY

Radioactive isotopes are being used as tracer elements to follow the course of chemical and physical processes, with emphasis at present on liquid metals as heat transfer media. The solubility of oxygen and iron in sodium and the influence of sodium oxide and hydroxide on the solubility of stainless steel components are being studied.

Analytical procedures have been developed for the sequence analysis of complex mixtures containing both radioactive and inactive isotopes. These techniques are being applied to studies of atmospheric radioactivities as well as other investigations.

C07 - MOLECULAR STRUCTURE

Research is conducted in all phases of molecular spectroscopy as applied to the determination of molecular structure, qualitative and quantitative analysis, and the interpretation of related optical, thermodynamic, physical, and chemical properties of materials. The immediate objective includes the application of infrared, ultraviolet, and mass spectroscopy to the solution of chemical problems such as the analysis of submarine atmospheres, the improvement of spectroscopic equipment and sampling techniques, and the acquisition of spectral data required for subsequent applications. Fundamental studies are made on the effects of intramolecular and intermolecular interactions on vibrational spectra.

C08 - PERSONNEL PROTECTION

Defenses against CW and BW agents are being studied, including measures to insure atmospheres safe for breathing. Research is confined to defensive aspects and covers:

(1) Mechanism of aerosol filtration.

(2) Formation and study of microfibers of various thermoplastic materials.

(3) Automatic and instantaneous detection of aerosols.

(4) Carbon-oxygen surface complexes.

(5) Protective clothing.

(6) Decontamination studies.

All of the chemical factors involved in providing a safe atmosphere in which men can live and work in closed spaces for extended periods of time are being studied. As related to nuclear-powered submarines this effort includes the development of an ultimate in methods of sampling, identification, and sensitivity in the determination of trace gases, vapors, and aerosols; the development of methods for generation of oxygen and the elimination of carbon dioxide, carbon monoxide, aerosols, and trace organic compounds; and the development of dependable shipboard methods for monitoring the concentration of

the components in such atmospheres. Many phases of this work are applicable in the solution of problems in other closed spaces, such as manned space flight.

The development of new materials and methods for fire extinguishment in naval ships, aircraft, and shore bases are being investigated. Primary emphasis is applied to the hazards of modern hydrocarbon, jet, and rocket fuels. The program includes prevention and control of fires from nuclear and guided missile power plants, and emphasis will vary as new energy sources are adopted.

ELECTRICITY

E01 - ELECTRIC POWER SYSTEMS

Investigations under this program embrace the requirements for and the application of electric power systems to military craft, with emphasis on a study of systems variables which affect design. Techniques of system protection to provide safety and reliability to the electric system of the vehicles are to be evolved.

Studies have been made principally on the electric power systems of submarines, aircraft, and space vehicles. They include work dealing with the transient characteristics of both ac and dc electric systems, with circuit protection, and with the general problem of system coordination. Under the latter program the factors effecting good system performance (regulation, stability, etc.) are investigated during both transient and steady-state periods of operation.

E02 - ELECTRIC POWER EQUIPMENT

The study includes factors affecting the performance and design of major electric components such as rotating machinery, control equipment, transformers, switch gear, and cable concerned with the generation, distribution, and utilization of electric power in military craft.

Studies of methods for cooling conventional electric equipment and for determining heating and coupling effects in bundles of cables have resulted in some practical standardization. Research is directed toward the analysis and invention of new electric power components for application to air and space vehicles, e.g., conversion of thermal and nuclear energy directly to electric energy.

E03 - ELECTRIC INSTRUMENTATION

Investigations under this program are concerned with electric instrumentation and equipment for military craft to cover special purposes such as measurement and computation, control, protection, alarm, interior communication, electric heating, electromagnetic braking, and electromechanical actuation. Under this program special circuitry is devised for the exploitation of newly discovered or improved characteristics of materials, both where the material makes possible development of new components and where it exhibits useful characteristics which require special instrumentation. The program includes (1) theoretical analyses of special components such as magnetic or dielectric amplifiers, (2) new developments in circuitry associated with paramagnetic resonance and gamma-ray-induced luminescence, and (3) applications of other solid-state phenomena. The development and application of computers and computer circuitry represent a continuing part of this program. Circuitry is being developed for multiple-channel telemetry for use in recovering data from earth satellites, missiles, and related equipments. Under the program there are engineering studies of the factors influencing behavior of insulation such as thermal aging, fatigue, high voltage surges, and radiation effects; consideration is also being given to the development of instrumentation for the prediction of insulation life.

MATHEMATICS

B01 - APPLIED MATHEMATICS

This program is devoted to the development of mathematical methods for extending the applicability of existing physical theories and the creation of new ones. Emphasis is placed on the fields of continuum mechanics, dynamics of complex structures, electrodynamics, statistical mechanics, and other statistical studies.

Completed studies have contributed to the theories of plasticity, fluid dynamics, dislocations, dynamics of finite systems, structural vibrations, and ultrasonic absorption. Present work primarily concerns general stress relations for continuous media, plasticity, the mechanics of finite systems, theories of armoring, and dislocations.

B02 - COMPUTERS

This program is designed to supplement and accelerate the scientific researches of the Laboratory by providing modern computing and data-reduction facilities to be applied to those problems which either cannot be solved by known analytical methods or demand machine methods because of the bulk of calculations involved. These needs are currently being met by a semiautomatic data-reduction system, a general purpose electronic differential analyzer, and a high-speed digital computer.

This program, in addition to furnishing computing and data-reduction services to the entire Laboratory, envisions the constant improvement of these facilities by developing and adding new components to the three systems and pursuing mathematical studies aimed at their more efficient utilization. These mathematical studies include investigations of the stability and accuracy of solutions, error analysis, automatic programming, and the development of a library of flexible subroutines.

MECHANICS

F01 - STRENGTH OF SOLIDS

Experimentally this program emphasizes study of the progressive development of initially localized plastic flowing and fracturing over a wide range of straining speeds. Suitable techniques are developed for plastic fibers, aircraft glazing, ship plate, armor, and other materials of naval interest.

The physical origins of penetration resistance of armor alloys of iron, aluminum, titanium, and magnesium-lithium are being identified. Instability criteria are being developed and applied to rate the toughness of aircraft glazing and structural materials. Studies of yield strength under dynamic loading, as by shock or ballistic impact, are directed toward disclosure of basic mechanisms and relative evaluation of various metals. Observations are made under cyclic stressing from frequencies of ten million in the elastic range to less than one per second in the plastic range.

Fracture-strength investigations of structures and materials are conducted. Applications are made of fracture-mechanics principles to strength problems of ships, aircraft, and missiles. Evaluations of large test samples and structures are facilitated by a three-million-pound-capacity loading machine which permits single cycle or repeated loadings in a versatile way. Experimental and analytical studies are made of the relation of brittle fracture to plastic strain as influenced by strain rate, temperature, specimen size, and other closely associated factors.

F02 - STRUCTURES

These investigations provide basic engineering for naval structures and devices which are beyond the range of existing theory. Speed and economy are sought by utilization of reduced-scale experiments and empirical methods.

The interaction effects between ships or missiles and the equipment attached thereon are being investigated by mechanical impedance techniques. Methods of designing equipment to resist dynamic loads have been developed and are being evaluated by predicting results of full-scale tests. Studies of response of structures (large or small) to random loadings are continuing. Predictions of the lethal shock radius of submarines subject to nuclear depth charges have been made. Expected submarine motions under depth charge attack have been predicted and analyses of protective mountings needed for large missiles are being completed. Participation in past and future large-scale field experiments is concerned chiefly with mechanical shock motions and underwater pressures.

F03 - SHOCK AND VIBRATION

Shock and vibration incident to naval service of equipment on ships, planes, and missiles are recorded, analyzed, and simulated. Methods are developed for the improvement of design techniques for obtaining adequate strength and for the development of suitable protective mounting arrangements.

Shock and vibration data obtained from static and in-flight measurements of various rockets are being used to develop specifications and design guides. Supporting investigations determine the physical properties of materials under dynamic conditions and develop instrumentation and methods of analyses as may be required. Ultrasonic techniques and resonant methods are being used to study changes of internal friction and elastic constants caused by plastic flow, fatique, and other factors. The techniques will be extended to determine the crystalline elastic module of small crystals. Prototype naval equipment are evaluated to determine their suitability for field environments; weaknesses are identified and remedies are applied or recommended.

F04 - PENETRATION BALLISTICS

This program utilizes laboratory penetration ballistics techniques with the object of extending their usefulness and exploring unknown characteristics of armor penetration and missile damage.

A major problem concerns the development of new knowledge of fundamental mechanisms of aircraft damage and, at the same time, appropriate techniques of quantitative analysis applicable to aircraft damage due to missile impact. The considerations being explored are organized under the headings: (1) component-system relations and analyses of vulnerability reduction, (2) measurement and analysis of illustrative models, (3) applicable game theory considerations, (4) penetration dynamics, and (5) flash and pressure associated with high-velocity impacts.

F05 - HEAT POWER

Heat power devices are investigated, with particular emphasis on the pulse-jet engine. Experiments are directed at a better understanding of the advantages and disadvantages of this type of engine and at improvement of characteristics such as fuel economy, service life, and thrust-drag ratio.

The valveless pulse-jet engine is under development as a gas turbine combustor with pressure gain. This combustor will be efficient, stable under a wide range of operating conditions including a zero speed start, and readily adaptable to heavy fuels. The savings in fuel consumption due to pressure gain rather than pressure loss make this application especially attractive in small gas turbines. The information gained in turbine combustor research can be utilized as well in helicopter propulsion unit design.

METALLURGY AND CERAMICS

M01 - PHYSICAL METALLURGY

Investigations of the effects of composition, processing, and heat treatment on the properties of metals and alloys are conducted with the aim of developing improved materials for naval use. The compatability of container metals with liquid metals, such as lithium, is being investigated in connection with problems of aircraft reactors. The effects of environmental conditions on creep and fatigue strength of high-temperature alloys are being studied; the environments include various gaseous atmospheres and liquids. The embrittlement of refractory metals including molybdenum is being investigated by the development of methods for the removal of deleterious impurities. The notch ductility characteristics of ultra-high-strength steels intended for high-performance aircraft and missiles is under investigation. Studies are being conducted on the basic mechanism of high-temperature creep and on alloy theory. Radiation damage to metals and magnetic materials is being investigated by tests of irradiated samples and also by inpile experiments.

M02 - MELTING AND CASTING

The objective of this program is to evolve new techniques and procedures required for the solution of casting problems of naval interest. The major effort is directed to the problem of reliability of castings intended for critical military applications. The investigations include studies of soundness, pressure tightness, variations of physical properties, and castability of complex shapes. Methods and procedures have been established to ensure the elimination of shrinkage regions and hot cracks in steel castings. The practicability of eliminating porosity leading to gas leakage in castings for optical and hydraulic applications has been demonstrated. Inexpensive equipment for vacuum degassing of melts has been developed and its use is being extended to various metals. High-strength non-magnetic steels are being developed for mine sweeper applications. Procedures for casting titanium are being investigated, including materials for use as expendable molds. Other work on molding materials is directed at investigations of methods which provide high surface quality and dimensional accuracy for conventional metals intended for use as missile components.

M03 - WELDING

This program is aimed at evolving fundamental information and developing new techniques and procedures required for the solution of welding problems. The major effort is directed to the evaluation of factors which determine the performance of weldments for hull structures, particularly under conditions of explosion loading. Mild steels, high-strength steels, and stainless-steel weldments are being investigated. It has been demonstrated that the notch ductility of the base steels controls the performance of mild-steel weldments while the performance of welded high-strength steels is controlled by the properties of the weld zone. Tests have been developed to provide for a better selection of steel for use at various possible service temperatures. Present studies concern the characteristics of steels and welds intended for hull construction of deep-diving submarines and very thick steels intended for pressurized water-reactor construction.

M04 - CORROSION

Basic studies of corrosion mechanisms are being conducted with the object of developing improved corrosion-resistant materials and protective systems for naval use.

This program includes:

(1) The identification of significant galvanic couples in sea water and development of protective systems for minimizing their effects.

(2) Studies of electrical potentials about ship hulls and development of cathodic protection systems using impressed current and/or sacrificial anodes for both active and inactive ships.

(3) Investigation of high-temperature aqueous corrosion characteristics of plain carbon steels, including the evaluation of inhibitors.

Detailed studies of the nature of corrosion films are being conducted in relation to the problems of high-temperature aqueous corrosion.

M05 - CERAMICS

New ceramic materials with particular characteristics for specific applications are under development. Methods for better control of ceramic materials are being studied in order to improve their reliability; emphasis at present is on barium titanate for sonar transducers. This program includes the investigation of such factors as effect of impurities or additives, methods of forming ceramics, and firing techniques, for the purpose of developing new and improved ceramic fabrication processes. It also includes a study of methods of production of ferrite crystals and garnets, an investigation of their magnetic and optical properties, and their application to specific military requirements.

NUCLEAR AND ATOMIC PHYSICS

H01 - NUCLEAR CONSTITUENTS AND STRUCTURE

Theoretical and experimental studies concerned with elementary particles, field theory, nuclear structure, nuclear reactions, and plasmas are being pursued. Calculations are being made of the properties of "strange particles" in support of specific experimental programs. Special mathematical representations of particles have been applied to parity-nonconserving interactions, and certain solutions of the many-body problem have clarified the volume and energy saturation properties of nuclear matter. A theoretical study is under way on the cross sections and polarization effects in the scattering of neutrons and protons by nuclei.

Low-energy nuclear interactions are being investigated experimentally with the aid of two 2-Mev Van de Graaffs, a 5-Mev Van de Graaff, two Cockcroft-Walton accelerators, and a 22-Mev betatron. Nuclear reactions are produced by beams of protons, deuterons, helium-3, helium-4, and photons in order to determine binding energies, nuclear energy levels, and quantum characteristics of various excited levels of nuclei. Proton-capture reactions are being extended to the medium-weight elements for which many nuclear levels, although quite close together, have been resolved and measured. By coulomb-excitation techniques, many low-lying levels have been discovered. An extremely precise electrostatic analyzer has been constructed and is being utilized to measure energies and widths of specific nuclear levels to a higher accuracy than heretofore possible. Measurements of the angle and energy distribution of the residual components in helium-3 induced nuclear reactions have indicated characteristics of direct interactions as well as compound-nucleus behavior. Monoenergetic neutrons are produced in charged-particle reactions and utilized in the measurement of elastic and inelastic cross sections at various energies. Nuclear resonance fluorescence is being produced by x-rays from the betatron, making possible the measurement of some of the properties of excited nuclear energy levels. Some photonuclear threshold energies and the angle and energy distribution of photo-alpha particles are also being measured.

In the field of high-energy physics, cosmic-ray studies are carried out with high-altitude balloon flights, and "strange particles" are investigated by means of exposures of nuclear emulsions at the Berkeley bevatron. In the former area, the emphasis is on the chemical composition, the energy spectra, and the interactions of the heavy primary nuclei of the cosmic radiation. Investigations of hyperons, K-mesons, and hyperfragments constitute the second area of high-energy research.

A program of investigation has been initiated utilizing the facilities of the NRL research reactor. Interactions between materials and neutrons of selected energies and polarizations are being studied. Resonance parameters, capture gamma rays, cross sections, crystalline and magnetic structures are under investigation. Nuclear parameters of excited states of reactor-produced short-lived radionuclides are being studied by methods of energy and lifetime measurement, delayed coincidence, angular and polarization correlations.

H02 - NUCLEAR INSTRUMENTATION AND TECHNOLOGY

Various methods and instruments for measuring nuclear radiation are being investigated. A continuing program of research and development is maintained toward the improvement of Geiger tubes, scintillation crystals and electron multiplier tubes, counting crystals, ion chambers, and proportional counters for use in radiac instruments. Standard known fluxes of alpha, beta, gamma, and x-rays have been established for providing calibration for the Navy's radiation detectors. Standard neutron fluxes are being established and a program is under way to develop crystals (such as LiH, LiF, and CdS) which have a high sensitivity to neutrons, for use as scintillation or conduction counters. This continuing program of investigation of components supports work in the radiac field and in nuclear power applications.

Theoretical and experimental studies are being made of the properties of intense beams of relativistic electrons and the feasibility of utilizing such a beam as a guide field for accelerating protons to billions of volts. To test some of these principles, work is progressing on the first phase of a uniquely designed, small aperture, 100-Mev electron synchrotron containing no iron for the guide field and making use of electromagnetic quadrupole lenses to concentrate the beam.

Research and development work is being carried out to produce extremely high-speed scaling equipment and automatic read-out systems. Such devices will eventually be used to instrument all reactor experimental apparatus.

H03 - NUCLEAR WEAPONS

Because of the possibility of the application of nuclear weapons to a host of unusual situations, a theoretical weapons study was initiated in collaboration with the Armed Forces Special Weapons Project. Work has been directed toward an understanding of weapons effects such as Teller light, the radiative phase of the explosion, and the shock wave. Application of the results of these studies has been made to several different situations.

An experimental study of shock waves and associated phenomena was stimulated by the theoretical weapons studies program. High-velocity shock waves in air have been initiated by electrically exploding a fine wire. Research is currently directed toward higher energy explosions and a study of the radiative characteristics of fire balls.

Measurements of optical and nuclear phenomena relating both to diagnostic and effects problems are made during nuclear weapons tests at the Nevada and Pacific Proving Grounds. The program includes the development and use of specialized electronic, photoelectric, spectroscopic, and nucleonic equipments as required for a variety of specific phenomena of interest.

H04 - NUCLEAR POWER

Effort is directed toward the problems involved in the utilization of nuclear reactors as sources of power for propulsion of naval vessels and aircraft, and toward direct use of reactors as sources of radiation. The program includes basic research upon fundamental parameters affecting power generation.

The NRL Reactor Facility is operated under this program as a part of the research effort. It provides radiation service within the Laboratory and to certain other Laboratories as well.

H05 - RADIATION EFFECTS

A program of fundamental research on the chemical effects of ionizing radiation is being carried out. The emphasis is directed toward reaching an understanding of the basic processes involved in radiation-induced chemical reactions. Since any predictions as to the behavior and lifetime of a material in a radiation field ultimately rest on a knowledge of the radiation chemistry of the compounds involved, this program should have important applications in the field of reactor technology.

H06 - ATOMIC PHYSICS

A program is in progress, involving both theoretical and experimental studies, to produce a steadily running, magnetically self-focusing stream of relativistic electrons and space-charge neutralizing ions by "stacking" the beam from a linear accelerator into a circular orbit.

Investigations are conducted on the production of the aurora and its effect on radio blackout. For this purpose, use is made of a laboratory tube, called the Störmertron, which reproduces on a small scale the complex orbits and ring currents formed by self-focusing streams of protons which migrate from the sun toward the earth.

A program of study of electron loss processes in ionized gases has been initiated. Pure gases maintained at low temperatures in a large chamber will be ionized by a high-energy electron beam. Measurements will be made on the attenuation, reflection, and phase shift of a microwave beam, which can be related to determine the recombination coefficients of the particular gas.

H07 - ULTRA-HIGH-TEMPERATURE PHYSICS

A research program in high-temperature physics has been stimulated by the possibility of producing a controlled thermonuclear reaction. To achieve this goal, research is being directed toward the production of multimillion-degree gases, the containment of ultra-hot gases, and the diagnostic techniques necessary to determine the character of the physical processes. Methods have been developed for magnetically compressing a million-degree plasma of shock-heated deuterium; temperatures of several millions of degrees are estimated to have been obtained by this technique. Work is being carried out to develop further the technique and produce higher temperatures and longer containment times.

OPTICS

N01 - PHYSICAL OPTICS

This program relates in a broad sense to the interaction of optical radiation and matter throughout the ultraviolet, visible, and infrared regions of the spectrum. It comprises basic investigations of the scattering and absorption of radiation by the atmosphere and the sea, the absorption and reflection of radiation by optical mirrors, optical crystals and filters, and the absorption by gases. Investigations are made of the spectral intensity of radiation from various sources, and the conditions necessary to the production of desired radiation characteristics. Methods are developed for the study of sources of radiation of extreme low brightness, such as self-luminous radioactive materials of a variety of colors. Spectroscopic investigations are conducted as required in the extreme and middle ultraviolet regions, in the visible, and in the infrared.

N02 - PHYSIOLOGICAL OPTICS

The optical properties of the human eye and the physical factors influencing its ability to see, both day and night, form the basis of this program. Studies are made (1) to determine the visibility of stars in the daylight or twilight sky for the purpose of navigation, (2) to investigate the conditions affecting visual detection of satellites, and (3) to ascertain the properties of the eye involved in the measurement of low brightnesses by visual photometry in connection with specifications of self-luminous markers and similar devices for nighttime operational use.

N03 - OPTICAL COMMUNICATION AND DETECTION

Investigations are made of detection, communication, and control systems which utilize ultraviolet, visible, or infrared radiations. The program includes applications of pulsed gaseous discharge light sources, and of detectors of radiation such as photoconductors, large thermopiles and solar blind photocells, photomultipliers, and photon counters.

RADIO

R01 - COMMUNICATION

It is the purpose of this program to investigate and develop systems and components for advancing short- and long-range communication between subsurface, surface, super-surface, and satellite units for all areas, including the polar regions, emphasizing such factors as choice of frequency, spectrum utilization, means for decreasing vulnerability, merits of various types of modulation, and provision for automatic operation. Systems will be studied which utilize audio, graphic, visual, and electromechanical techniques to improve such factors as traffic handling capacity, security, accuracy, flexibility, and reliability. Relay and data-transmission systems for the transfer of information or intelligence to achieve increased speed, accuracy, and range extension will also be investigated. The studies will be oriented toward improvement of all naval radio communication for task force, fleet, and shore stations as well as communication between such stations by the utilization of satellites, outer space craft, and missiles.

The work in communication is along two main lines: development of new or better communication services, and increase of reliability and utility of present services. New services are being developed for the purpose of (1) conserving spectrum space, (2) improving the reliability and capacity of communication circuits, and (3) making communication more secure through the development and application of new techniques and through the use of the propagation properties of extremely short wavelengths.

The reliability and utility of existing services are being improved by redesign and modernization of components and circuits and by exploitation of new components and techniques such as transistors and information quantizing. New techniques are being evolved for the computation of theoretical performance capability and performance analysis of systems and equipment. Principles and techniques of centralized electronic control and discipline of communication equipment in naval craft and shore establishments are also being developed.

R02 - RADAR

Investigations are conducted on detection techniques and systems, precision tracking techniques, high-resolution systems, and correlation and signal-storage techniques. Among the objectives of these investigations are Navy radars with improved sensitivity, reduced vulnerability to electronic countermeasures, increased accuracy, increased information rate, effective discrimination against unwanted targets, improved resolution of multiple targets, and greater reliability. An important part of the radar program consists of consultative services provided to the Bureaus, the Services, and their contractors.

The detection program covers work in these major areas:

(1) Long-range surveillance of all radar targets above the radar horizon including detection of aircraft, missiles, and astronautical vehicles, and providing functions required for air defense by means of both shipborne and airborne systems; short-to-medium-range target indication systems for designation to and augmentation of the tracking function of weapons systems; and submarine detection using radar or radar techniques.

(2) Studies of high-resolution techniques and systems, including particularly short-pulse generation and amplification, wide-band amplifiers and display devices, pulse-compression techniques for achieving range resolution greater than obtainable by conventional means for a given pulse length, and investigation of target and clutter characteristics using high range resolution.

(3) The study of crosscorrelation and storage techniques for enhancement of radar sensitivity, the application of these techniques at high frequencies to enable over-the-horizon detection by reflection from the ionosphere, study of characteristics of the ionosphere and backscatter and aircraft signals, and a magnetic-drum-storage correlation radar system having high velocity resolution.

The objective of the tracking program is to advance the state of the art of precision radar tracking and to extend its utility and capabilities for advanced surface, airborne, and in-space applications. Research and development efforts are directed toward improving acquisition, resolution, tracking accuracy, target identification and counter-countermeasure techniques. Studies of fundamental parameters such as target reflectivity characteristics lead to new concepts which are explored theoretically and empirically. New systems, techniques, and components of immediate or potential value are evolved. The tracking radar program is closely related to the work in progress under the R05 program.

R03 - RADIO IDENTIFICATION

It is the purpose of the program to analyze operational requirements for electronic recognition and identification systems, to evolve techniques and special components applicable to such systems, to develop experimental systems, and to provide consultative services on construction, use, and operation of final equipments.

The present Mark X IFF system is being improved in size, weight, and reliability through the application of transistors, printed circuitry, and redundancy techniques. Research on the new Mark XII IFF system is at an advanced stage. Various schemes are under study to maximize security of interrogation and response.

R04 - RADIO NAVIGATION

This program serves to investigate navigation systems with a view toward future program requirements of the Navy. Studies are being conducted to develop specific navigational systems enabling aircraft to perform all functions necessary for military missions. Also sought are developments of short-range navigation systems for small surface or subsurface units providing position or guidance information, and long-range systems with provision for security and other military requirements for subsurface, surface, supersurface, and satellite units. Under this program are included short-range high-precision radio-navigation systems for mine-defense operations.

The program involves the use of new techniques in navigation of aircraft and ships. These include use of radar and inertial systems as well as light and radio emission from celestial objects. The emphasis is on self-contained systems, particularly on those which can be carried on small or medium-size aircraft. Applications to bombing systems, strip mapping, and automatic or semiautomatic control of aircraft are included.

R05 - WEAPONS CONTROL

Investigations of weapons control systems include the determination and study of all factors related to control accuracy, the development and application of standard and advanced techniques, and systems integration and performance evaluations. Emphasis is on shipboard and aircraft systems for gunfire control, rocket launching control, missile guidance and control, aircraft flight control with trends toward more complete automation. The programs involve radar, infrared, optical, and acoustic techniques with wide application of servo-system theory to tracking, stabilization, launching, landing, aerodynamic control, gun laying and rocket laying, and missile guidance. Research on recording, computing, data reduction, system simulation, and telemetry techniques and equipment provides the basis for proving-ground instrumentation and for control system development and evaluation.

The program in automatic control is directed toward the following:

(1) Missile guidance. This covers fundamental measurements on propagation phenomena, development of techniques to overcome propagation limitations, development of instrumentation for research in automatic guidance systems for aircraft and missiles, and consultation with Navy Bureaus, Special Projects Office, and with other services on missile-guidance development and its coordination.

(2) Fire-control systems. This program engages in evaluation studies of airborne and surface systems and operational research on complete systems under simulated tactical conditions. Furthermore, the program covers the application and integration of components of such systems to all-weather aircraft control systems for carrier-based aircraft and consultant service to the Navy Department and associated contractors on fire-control problems.

(3) Space studies. This program concerns the application of servo theory and radar techniques to moon tracking and radio astronomy problems.

The program in weapons systems development is directed toward the following:

(1) Airborne missile systems. This program engages in all elements of the system including electromechanical, electronic, environmental, and tactical considerations. The work includes technical direction of system studies for the Bureau of Aeronautics, working with associated contractors to investigate fundamental requirements of the system when employed in a fleet tactical environment, and supplemental studies and experimental investigations in circuit analysis, system design, and integration problems.

(2) Fleet Ballistic Missile The program to support the FBM covers system aspects, carries out studies, and coordinates research conducted at NRL which can be applied to FBM problems.

R06 - RADIO COUNTERMEASURES

Techniques for exploration of the complete radio spectrum are evolved, with primary emphasis on such fields as interception, direction finding, signal analysis, and vulnerability. Work is also carried out on jamming and deception techniques which can be applied against all radio and radar systems. The vulnerability of U.S. (and where possible, foreign) radio and radar equipments is being studied as an aid toward devising countermeasures. The program includes the development of jamming and deception methods,

techniques, and experimental systems for use against all types of radar and radio systems. Experimental devices and systems are being developed for use in aircraft and ships for evaluation of various newly devised techniques.

R07 - RADIO PROPAGATION

The propagation of electromagnetic waves is studied including extraterrestrial, ionospheric, tropospheric, ground-wave and sea-water propagation. Propagation of these waves through exhaust flames of both liquid- and solid-fuel rocket engines is receiving a continuing study directed toward increasing the reliability of radio links and extending radio communications and control services.

Attention is given to reflections from natural and man-made objects and back scattering from the absorption by clouds, rainstorms, and sea or ground surface, with emphasis on quantitative results and the physical characteristics of the reflected waves. An important related problem is the radar detection of small targets in the presence of sea return.

Meteorological phenomena are measured both on the ground and in the troposphere along radio-wave paths. Anomalies in electromagnetic wave propagation are then related directly to existing atmospheric conditions.

Studies are being made to determine the phase stability of very-low-frequency radio signals which are transmitted over great distances. Stress is being placed on determining the phase coherence of two very-low-frequency signals differing a few hundred cycles per second in frequency.

Techniques and methods are being developed for the electronic computation of propagation attenuation curves for use in system analysis.

R08 - ELECTRONIC COMPONENTS AND INSTRUMENTATION

Components and materials associated with electronic circuitry are being investigated and new forms and techniques of application developed which will contribute to improved performance, stability, simplicity, compactness, flexibility, weight, and reliability of electronic equipment and devices. Studies are being made in the fields of frequency generation, precise determination of time, system and circuit gain, signal detection and modulation, synchronization of events, control of systems and equipments, information storage and reproduction, and economy of spectrum utilization. The program includes research in electronic measurements and the development of new techniques and instrumentation for laboratory and operational applications. Particular effort is being made in the field of frequency invariant devices and circuitry employing such physical elements as quartz and other materials, and exploiting atomic resonance and other basic physical phenomena. Techniques and means of coordinated or centralized control of frequency and time in systems are being developed.

Properties of electronic devices using new solid state materials, such as the Maser (microwave amplification by stimulated emission of radiation), are investigated for application to electrical circuits or rf systems. Microminiaturization of circuits is being pursued through deposition of both passive and active elements by vacuum techniques.

Research and development is conducted in the fields of electron tubes and semiconductor devices. Some tube problems are: electron storage tubes, improved cathode emission, millimeter-wave oscillators, and high-density steady-state gas plasmas. Semiconductor devices under study are improved point-contact diodes, multicontact diodes, multistable transistors, and transistors controllable by external effects, such as light or magnetic fields.

R09 - ANTENNAS

Theoretical and experimental research is directed toward the development of new and improved antennas, antenna components, rf components closely allied to antennas, and antenna instrumentation. Techniques are being developed for the computation of the theoretical radiation patterns of idealized antennas.

The work may be classified into three categories:

(1) Development of antenna systems for radar, communication, and navigation equipments; study of complete buoy systems for submerged very-low-frequency reception of communication and navigational signals,

(2) Development of antenna techniques, such as rapid-scan systems for radar, retarded-wave antennas for carrier-based airborne early warning systems, and flat spiral antennas for large scanning arrays,

(3) Research in techniques having general antenna application, such as ferrite control of the propagation of microwaves in waveguide.

Stress is placed on simplification of shipboard antenna systems by broadband design and multiple use of single antennas, and on flat two-dimensional antenna arrays scanned by electronic means.

SOLID STATE PHYSICS

P01 - SEMICONDUCTORS

This program is concerned with theoretical and experimental analyses of semiconductors. It includes development of new and improved semiconductors such as silicon, cadmium sulfide, and germanium through investigation of different methods of preparation and treatment, and application of these materials to such uses as radiation detectors, rectifiers, transistor diodes, and triodes. The contribution of surface states to electrical and optical properties is being studied to assist in the improvement of semiconductors for certain applications and to further the knowledge of such phenomena as luminescence, contact barriers, photoconductivity, catalytic behavior, and chemisorption.

P02 - MAGNETIC MATERIALS

This program includes basic research in such ferromagnetic properties as relaxation times and anisotropy, magnetostriction, g-factor, susceptibility, and saturation moments. Investigations at high frequencies are applied to the development of rf absorbent material, and studies of complex permeability and dielectric constants of magnetic oxides and ferrites are used for improving rf components. Information developed thereby is applied to the development of rf camouflage, dummy loads, and rf absorbent rooms. Both electron and nuclear resonance physics are included in this program to provide basic information for the development of better materials for magnetic detection devices. Under this program there has been an investigation of solid state Masers. This development is expected to be of value in the development of ultra-high-frequency amplifiers and oscillators.

P03 - DIELECTRICS

This program includes theoretical and experimental investigation of the physical properties of insulators, crystals, and luminescent materials. Lattice dislocation, ionization, molecular decomposition, and related solid state phenomena are investigated by radiation methods.

Luminescence investigations include studies in mechanisms of luminescence, color centers, and effects of ionizing radiation as well as of structure and composition of luminescent materials and the effects of sensitizing additives. Phenomena of luminescence and coloration are exploited in new applications such as in light production, cathode-ray-tube presentations, and dosimetry of ionizing radiation. A fundamental investigation is being undertaken of the value of a wide variety of glasses as sources of luminescence for specific applications; this work is directly related to the development of multicolored cathode-ray tubes. Under this program transparent films deposited by evaporation are being developed for application both to color television and to a two-color transparent cathode-ray screen for use in military aircraft.

Fundamental research on optical, photoconductive, electrical, and related properties is carried out to obtain basic information needed in the development of improved dielectrics for detection devices, radiation windows and filters, light modulators, transducers, etc.

P04 - GROWTH AND STRUCTURE OF SOLIDS

Basic physical phenomena are related to structure in an effort to improve methods of preparation and utilization of materials and the exploitation of their characteristics. Investigations of crystal growth involve study of the mechanism and development of specialized crystal growth techniques such as water solution, vapor phase, melt, flame fusion or hydrothermal methods. Growth techniques are applied to the production of special crystals involving optical, piezoelectric, photoconductive, and other properties. Phase diagrams and crystal structures are determined. X-ray diffraction is applied to (1) fundamental investigations of the crystalline state and composition of materials and (2) fundamental investigations of the effects of temperature and stress on phases in alloys and on the diffractive properties of single crystals. Techniques are developed for studying the chemical composition of materials by means of their characteristic x-ray spectra excited directly or by fluorescence. The composition of inhomogeneities, precipitates, phases, and diffusion regions are investigated over areas as small as 0.001 mm in diameter with the newly developed electron probe x-ray microanalyzer. Electron microscopy is used as an adjunct to x-ray techniques for pictorial resolution of specimen detail. This program includes other basic investigations in the physics of metals and metal alloys. Plastic deformation, internal friction, band theory, and related phenomena such as conductivity, the Hall effect, permeability, hysteresis, and magnetostriction are investigated.

P05 - CRYOGENICS

This program is concerned with basic research in solid state physics at low temperatures where thermal energies are comparable to the interaction energies under study. Coordinated theoretical and experimental studies of low-temperature phenomena are of value in the development of solid state theory and may also result in the utilization of the unusual low-temperature properties of materials in the development of new instruments and techniques of research. With primary interest in metals, research includes studies of electrical and thermal conductivity, lattice dynamics with free-electron effects, superconductivity, magnetoresistance, paramagnetism, and antiferromagnetism. In addition to basic solid state studies, research is performed in the production and utilization of low temperatures and in thermometry and instrumentation at these temperatures.

SOUND

S01 - SOUND PROPAGATION

The interaction between sound and the media in which it is propagated is investigated over a wide range of frequency and intensity. The dependence of such interaction on temperature, temperature gradient, salinity, and depth and boundaries of the ocean is determined. Ambient noise in the ocean and ships' self-noise are studied.

The conditions under which certain acoustic paths, not commonly employed, may be put to use to add assurance of obtaining minimum acceptable detection ranges in Anti-submarine Warfare (ASW) are being studied theoretically and experimentally in the field. The utilization of an assigned experimental submarine will augment this effort. The lack of agreement in the observed absorption in actual sea water and in magnesium sulfate solutions leads to further investigation of the mechanisms of propagation loss. Determination of pressure coefficients in the equation for sound velocity in sea water is being continued.

S02 - TRANSDUCERS

The mission of research in this field is to investigate means for generating underwater sound, for converting sound to electric power, and for realizing desired directional and frequency response characteristics in sound sources and receivers.

In view of the requirements for improved transducers for ASW, emphasis is currently placed on radiation from arrays, high-power handling capacity with high efficiency, and wide-band frequency response. Weight reduction continues to be important. The control of characteristics of passive materials is receiving increased attention. Experimental transducers as instrumentation for the assigned experimental submarine are being developed.

S03 - SOUND SIGNAL ANALYSIS AND PROCESSING

Signals and background encountered in underwater sound work are analyzed. The application of electric networks to processing these signals and the presentation of the signals to human operators for interpretation are studied. Information theory and computer techniques are applied to the detection of targets and to the interpretation of target characteristics and maneuvers.

Work under this program includes the analysis of sonar signals and backgrounds under a variety of conditions to determine what types of electronic processing are most effective for target detection and classification. The effects of data processing and display characteristics on operator performance are determined. Target-detection systems using visual data presentation, which have provided a significant improvement over existing equipments in both detection range and target information rate, are being further improved.

New analysis techniques using electronic computing equipment are being applied to recorded sonar data, new display techniques for matching the information contained in

sonar signals to the human aural and visual senses are being studied and tested, and the results of this research are being used in the design of target-detection equipments both for making optimum use of operators and for automatically indicating the presence of a target.

S04 - DOMES AND TOWED BODIES

Problems attacked in the field of submerged domes and towed bodies include hydrodynamic flow, launching and retrieving, stabilization, and steering. The stresses and strains produced in hydrodynamic structures and their supports are studied. Characteristics of sound windows and absorbers are determined. A study of dome noise is currently being emphasized to contribute to ASW.

S05 - SONAR SYSTEMS

Systems for all sonar carriers are studied to extend the detection range in ASW; to improve classification, identification, and target resolution, and to obtain more precise tracking and attack information. Systems are tested at sea to obtain scientific data which are correlated with theory.

Contributions to the problem of target classification are being made. The latest long-range detection and attack systems are providing promising data. Emphasis is being increased on systems to extend assured range.

SPECIAL SERVICE FUNCTIONS

K01 - ENVIRONMENTAL FACTORS INFORMATION

Interchange of information is coordinated in the field of shock, vibration, and combined environments, including temperature, pressure, and radiation. Methods are devised for channeling related current knowledge to all workers in the field to help eliminate duplication of effort and blind-alley investigations. Planned conferences and symposia are employed to disseminate the information. Policies are set by the Interservice Technical Group, composed of Army, Navy, and Air Force representatives. The subject for a particular symposium is selected by a nation-wide survey to determine the problems of environment most needing study. Benefits of the series of symposia are extended and consolidated through the publication and distribution of a Bulletin.

Advice is rendered, consultation provided, and recommendations are made upon request from government agencies with respect to new test facilities, contemplated research projects, and measurement techniques.

K02 - HARBOR DEFENSE INFORMATION

Technical and scientific consultation is provided to the Office of Naval Research and the Chief of Naval Operations in matters relating to harbor defense. Information on the various technical aspects of the problem is coordinated and integrated, and current knowledge for the over-all program is disseminated.

The Harbor Defense and Countermeasures Bulletin is published and distributed to authorized activities and individuals needing the information. Articles in this Bulletin are written by invited specialists in the fields of magnetism, sonar, radar, mines, torpedoes, nets, etc.

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